10/767,073

Amendments to the Claims

1-39. (Cancelled)

40. (Previously presented) An optical audio disc having an area storing an audio title set (ATS), the audio title set (ATS) including data representing a digital audio signal resulting from steps including (1) quantizing a first original audio signal at a first sampling frequency (fs1), (2) quantizing a second original audio signal into a quantization-resultant audio signal at a second sampling frequency (fs2), and (3) subjecting the quantization-resultant audio signal to a bit shift, the first original audio signal being in a first channel group having multiple channels, the second original audio signal being in a second channel group having multiple channels, the first sampling frequency (fs1) being assigned to each of the channels in the first channel group, the second sampling frequency (fs2) being assigned to each of the channels in the second channel group, the bit shift having a quantity common to the channels in the second channel group;

the audio title set (ATS) including data representing the first sampling frequency (fs1) and the second sampling frequency (fs2), data representing the quantity of the bit shift and channel assignment information for identifying the channels in the first channel group and the channels in the second channel group;

the area also storing audio manager (AMG) containing data for controlling the digital audio signal and the data for displaying menu of the digital audio signal.

ok for 369/47.16

41. (Previously presented) A signal encoding apparatus comprising:

means for generating information; and

means for formatting the information into a data structure;

wherein the data structure has an area containing an audio title set, the audio title set including data representing a digital audio signal resulting from steps including (1) quantizing a first original audio signal at a first sampling frequency, (2) quantizing a second original audio signal into a quantization- resultant audio signal at a second sampling frequency, and (3) subjecting the quantization-resultant audio signal to a bit shift, the first

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[0084] The main beam former combines the detected signals from all or a subset of the signal detectors to provide the speech plus noise signal s(t). The main beam former may be implemented with various designs. One such design is described in detail in copending U.S. patent application Ser. No. ______ [Attorney Docket No. 122-1.1], entitled "Noise Suppression for a Wireless Communication Device," filed Feb. 12, 2002, assigned to the assignee of the present application and incorporated herein by reference.

[0085] The blocking beam former combines the detected signals from all or a subset of the signal detectors to provide the mostly noise signal x(t). The blocking beam former may also be implemented with various designs. One such design is described in detail in the aforementioned U.S. patent application Ser. No. ______ [Attorney Docket No. 122-1.1].

[0086] Beam forming techniques are also described in further detail by Bernal Widrow et al., in "Adaptive Signal Processing," Prentice Hall, 1985, pages 412-419, which is incorporated herein by reference.

[0087] The speech plus noise signal s(t) and the mostly noise signal x(t) from beam forming unit **720** are provided to signal processing unit **730**. Beam forming unit **720** may be incorporated within signal processing unit **730**. Signal processing unit **730** may be implemented based on the design for signal processing system **200** in **FIG. 2** or some other design. In an embodiment, signal processing unit **730** further provides a control signal used to adjust the beam former coefficients, which are used to combine the detected signals v(t) from the signal detectors to derive the signals s(t) and x(t).

[0088] **FIG. 8** is a diagram illustrating the placement of various elements of a signal processing system within a passenger compartment of an automobile. As shown in **FIG. 8**, microphones **812***a* through **812***d* may be placed in an array in front of the driver (e.g., along the overhead visor or dashboard). Depending on the design, any number of microphones may be used. These microphones may be designated and configured to detect speech. Detection of mostly speech may be achieved by various means such as, for example, by (1) locating the microphone in the direction of the speech source (e.g., in front of the speaking user), (2) using a directional microphone, such as a dipole microphone capable of picking up signal from the front and back but not the side of the microphone, and so on.

[0089] One or more microphones may also be used to detect background noise. Detection of mostly noise may be achieved by various means such as, for example, by (1) locating the microphone in a distant and/or isolated location, (2) covering the microphone with a particular material, and so on. One or more signal sensors **814** may also be used to detect various types of noise such as vibration, engine noise, motion, wind noise, and so on. Better noise pick up may be achieved by affixing the sensor to the chassis of the automobile.

[0090] Microphones **812** and sensors **814** are coupled to a signal processing unit **830**, which can be mounted anywhere within or outside the passenger compartment (e.g., in the trunk). Signal processing unit **830** may be implemented based on the designs described above in **FIGS. 2 and 7** or some other design.

[0091] The noise suppression described herein provides an output signal having improved characteristics. In an automobile, a large amount of noise is derived from vibration due to road, engine, and other sources, which dominantly are low frequency noise that is especially difficult to suppress using conventional techniques. With the reference sensor to detect the vibration, a large portion of the noise may be removed from the signal, which improves the quality of the output signal. The techniques described herein allows a user to talk softly even in a noisy environment, which is highly desirable.

[0092] For simplicity, the signal processing systems described above use microphones as signal detectors. Other types of signal detectors may also be used to detect the desired and undesired components. For example, vibration sensors may be used to detect car body vibration, road noise, engine noise, and so on.

[0093] For clarity, the signal processing systems have been described for the processing of speech. In general, these systems may be used process any signal having a desired component and an undesired component.

[0094] The signal processing systems and techniques described herein may be implemented in various manners. For example, these systems and techniques may be implemented in hardware, software, or a combination thereof. For a hardware implementation, the signal processing elements (e.g., the beam forming unit, signal processing unit, and so on) may be implemented within one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), programmable logic devices (PLDs), controllers, microcontrollers, microprocessors, other electronic units designed to perform the functions described herein, or a combination thereof. For a software implementation, the signal processing systems and techniques may be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. The software codes may be stored in a memory unit (e.g., memory **830** in **FIG. 8**) and executed by a processor (e.g., signal processor **830**). The memory unit may be implemented within the processor or external to the processor, in which case it can be communicatively coupled to the processor via various means as is known in the art.

[0095] The foregoing description of the specific embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein, and as defined by the following claims.

What is claimed is:

1. A signal processing system used in automobile to suppress noise from a speech signal comprising:

a first signal detector configured to provide a first signal comprised of a desired component plus an undesired component, wherein the desired component includes speech;

a second signal detector configured to provide a second signal comprised mostly of an undesired component;